Urol Res (2009) 37:369–376
DOI 10.1007/s00240-009-0224-2

SYMPOSIUM PAPER

Retrieval methods for urinary stones

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Received: 26 September 2009 / Accepted: 1 October 2009 / Published online: 16 October 2009

Abstract This paper attempts to assess the current status of the various modalities of available treatment for urinary stone disease in the Kerala scenario. A total of 300 patients who attended the stone clinic with urinary stone disease and had stones retrieved by different means were selected for the study. Their clinical symptoms, demographic profile, size, number and position of stones, metabolic profiles, retrieval modalities and end result of treatment in terms of stone clearance were assessed. Instances of failure, incomplete clearance and complication events were noted. Based on the experiences, a flowchart was created for appropriate decision-making in urinary stone management. The modalities of retrieval included nephrectomy, nephrolithotomy, pyelo-nephrolithotomy, extended pyelolithotomy, pyelolithotomy, ureterolithotomy, cystolithotomy, urethrolithotomy, ESWL, PCNL, URS, cystolithotripsy, urethrolithotripsy and spontaneous passage. The clearance rate of stone was maximum in open surgery. The extent of stone clearance by ESWL depended on various factors. PCNL was mostly limited by the difficulties in achieving puncture at the stone site. Availability of a variety of flexible nephroscopes also altered the success rate of the procedure. There were good success rates in pushing stones from the ureter to the pelvis followed by PCNL. In patients who had successful PCNL, postoperative morbidity was significantly reduced in terms of the number of days of hospitalization, time taken for return to work, absence of urinary leak, site infection, urinoma formation and urinary tract infection. URS was performed in many patients and stones retrieved. However, the indication for the procedure remains doubtful as the size of most of the stones thus retrieved was less than 6 mm. These would have passed out spontaneously or with chemotherapeutic support. URS, lithotripsy and basketting were confronted by upward migration of stones to the kidney, requiring further procedures for retrieval. Introduction of double J stents helped in relieving urinary obstruction, particularly in patients presenting with anuria, but retained stents, forgotten stents and failed stone retrieval were common following the procedure. The procedure of URS was simplified by the presence of dilated ureter in spontaneous stone passers or those with distal obstruction and proximal dilatation. It is concluded from the study that open surgery still remains the sheet anchor of treatment of urinary stones in many patients in Kerala. Newer lesser invasive procedures should be ethically selected. Decisions should be patient based, taking into consideration the economic feasibility for the procedure proposed.

Keywords Urinary stone · Retrieval · ESWL · PCNL · URS · Open surgery · DJ stent · Stone clearance · Push bang · Conversion

11th international symposium on urolithiasis, Nice, France, 2–5 September 2008 Urological Research (2008) 36:157–232. doi: 10.1007/s00240-008-0145-5. http://www.springerlink.com/content/x263655772684210/fulltext.pdf.

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Introduction

Surgery has been the main stay in the retrieval of urinary stones since the earliest days of clinical science. "Cutting for

stone" was left to the specialist in surgery in the earlier days. In later years, management of stones, particularly staghorn calculi has been centred on aggressive surgical retrieval [1, 2]. Modifications in surgical techniques utilizing Gil-Vernet's plane [3] have improved the chances of complete clearance of stones from the kidneys. Several newer modalities of treatment have come up in recent years, so that the treatment of urinary stone disease has acquired the most revolutionized options. Advent of shock-wave treatment [4] and endoscopic instrumentations such as PCNL [5, 6] and URS [7] have given a lot of fillip to less invasive treatment schedules for stone disease. This paper attempts to assess the current status of the various modalities of available treatment for urinary stone disease in Kerala in south India.

Methods

Three hundred patients who attended the stone clinic from 2003 to 2008 with urinary stone disease and had stones retrieved by different means were selected for the study. Their clinical symptoms, demographic profile, size, number and position of stones, metabolic profile, retrieval modalities and end result of treatment in terms of stone clearance were assessed using a proforma (Table 1). Instances of failure, incomplete clearance and complication events were noted. Based on the experiences, a flowchart was created for appropriate decision-making in urinary stone management in the kidney, ureter, bladder and urethra.

Table 1 Proforma for stone retrieval study

Reg.No:		Date:
Name:		Age: Sex:
Domicile:	Local / Gulf returned / other	
Diagnosis:	Stone / Colic / Crystalluria / Haematuria	
Total Duration:	yrs months	No. of stone episodes:
Type of stone:	LR / RR / LU / RU / Bladder / Urethra / Multiple	
If multiple:	Same side (LUT / Passer) / Opp. side (LUT / Passer)	
Co morbid conditions	: DM/HT/Other	
Clinical symptoms	: Dull pain / colic / LBA/LAP / dysuria / burning / haematuria / crystalluria / lithuria / Nil	
Metabolic profile	: Ca / UA / Ox / Citrate / Other	
Procedure undertaken	1. Nephrectomy	2. Nephrolithotomy
	3. Pyelonephrolithotomy	4. Extended pyelolithotomy
	5. Pyelolithotomy	6. Ureterolithotomy
	7. Cystolithotomy	8. Urethrolithotomy
	9. ESWL	10. PCNL
	11. URS	12. Cystolithotripsy
	13. Urethrolithotripsy	14. Spontaneous passage
Success of procedure	:	Successful / partially successful / failed
Friability of the stone	:	Friable / non friable
Stone Composition	:	COM / COD / COM+COD / UA / Mixed / Other
The clearance rate	:	%
Urinary leak	:	days
Wound infection	:	Nil / minimal / moderate / gross
Urinoma formation	:	Yes / no
Urinary tract infection	:	Yes / no
DJ stent	:	Yes / no
Post operative morbidity	:	days
Total hospitalization	:	days
Time taken for return to work:		days

LR *Left renal*
RR *Right renal*
LU *Left ureteric*
RU *Right ureteric*
LUT *Lower urinary tract*
DM *Diabetes mellitus*
HT *Hypertension*
LBA *Low back ache*
LAP *Low abdominal pain*
Ca *Calcium abnormality*
UA *Uric acid abnormality*
Ox *Oxalate abnormality*

Table 2 Success rate of different modalities of stone retrieval

No.	Parameter	Number	Percentage	Clearance rate %
1	Nephrectomy	1	0.3	100
2	Nephrolithotomy	42	14.0	78
3	Pyelonephrolithotomy	64	21.3	41.66
4	Extended pyelolithotomy	28	9.3	69.56
5	Pyelolithotomy	64	21.3	21.88
6	Ureterolithotomy	36	12.0	68.63
7	Cystolithotomy	5	1.7	100
8	Urethrolithotomy	4	1.3	100
9	ESWL	36	12.0	25
10	PCNL	28	9.3	36
11	URS	37	12.3	78
12	Cystolithotripsy	12	4.0	56
13	Urethrolithotripsy	1	0.3	100
14	Spontaneous passage	76	25.3	–
	Total	434	144.7	

ESWL Extracorporeal shock-wave lithotripsy, *PCNL* Percutaneous nephro-lithotomy, *URS* Ureterorenoscopy

Fig. 1 Bilateral staghorn stones ideal for open surgery

Results and discussion

A total of 434 retrieval methods were recorded in the 300 patients studied. The patients included in the study comprised left renal, right renal, left ureteric, right ureteric, bladder and multiple site stones, multiple stones in single location and multiple stones in multiple locations. The morphological studies did not indicate any significant variation among the different groups of patients who underwent different modalities of retrieval. This is attributed

Fig. 2 Stone in the right renal pelvis ideal for ESWL

Fig. 3 Bilateral renal stones ideal for PCNL

Fig. 4 Upper calyceal stone requiring puncture from above

to the fact that in the present study, in most situations, the cost factor of endoscopic procedures decided the choice of procedures. Open surgery was possible in most government institutions where treatment is basically free. Advanced techniques were available mainly in corporate hospitals with high financial burden on the patient. Selection of the modality of treatment suggested to the patient was based on the location, size, number and position of stones, the metabolic profile of the patient and financial capability of the patient. The retrieval modes included nephrectomy (1), nephrolithotomy (42), pyelonephrolithotomy (64), extended pyelolithotomy (28), pyelolithotomy (64), ureterolithotomy (36), cystolithotomy (5), urethrolithotomy (4), ESWL (36), PCNL (28), URS (37), cystolithotripsy (12), urethrolithotripsy (1) and spontaneous passage (76).

The rate of stone clearance achieved by the various procedures is detailed in Table 2. The clearance rate of stones was maximum in open surgery. Figure 1 shows a typical X-ray. The extent of stone clearance depended on various factors. In shock-wave lithotripsy, the important factors included type of ESWL machines, technical expertise of the technicians/radiographer using the machine, bulk of stones based on size and number, location of renal stones (pelvic or calyceal), expertise of the urologist in deciding the number of shock waves and abandoning the procedure at the appropriate shock wave level and cost factor implications. Figure 2 shows an ideal stone for ESWL, where the stone is inside a dilated pelvis.

PCNL was mostly limited by the difficulties in achieving puncture at the stone site. The technical competence of the surgeon and the quality of the C arm X-ray machine decided the success rate of the approach. Further, the friability of the stone equated to the competence of the lithotripter added to the fate of the success or failure of the procedure. Availability of a variety of flexible nephroscopes also altered the success rate. Figure 3 depicts a patient's X-ray, which shows bilateral renal stones, ideal for PCNL. The stone identified in Fig. 4 in the upper calyx was retrieved using puncture from above. Pushing stones from the ureter up to the pelvis followed by PCNL had good success rates (push bang) probably because of the small size of the stones involved and the accessibility of the stones in the pelvis (Fig. 5). The bulk of the stones (size and number) and location (pelvic or calyceal), as well as the anatomy of the urinary tract (intrarenal or extrarenal pelvis), also mattered in the success rate. In patients who

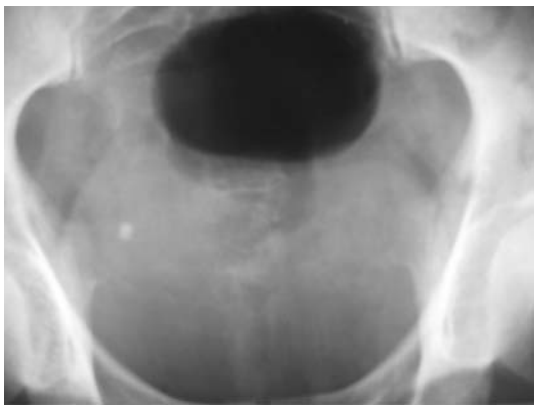


Fig. 6 Lower ureteric stone, which would have passed spontaneously

Fig. 5 Left upper ureteric stone ideal for "push bang"

Fig. 7 Bilateral ureteric stones, where URS failed in the first attempt. DJ stents could not be passed beyond the stones on both sides

Table 3 Morbidity pattern of different modalities of stone retrieval

No.	Parameter	Complications number and %	Hospital stay in days	Days to work
1	Nephrectomy	Nil	9	45
2	Nephrolithotomy	2–4.8	9.8	78
3	Pyelonephrolithotomy	3–4.9	9.3	41.66
4	Extended pyelolithotomy	2–7.1	9.3	50.3
5	Pyelolithotomy	2–3.1	8.6	39.5
6	Ureterolithotomy	1–2.8	8.1	35.7
7	Cystolithotomy	Nil	6.7	28.6
8	Urethrolithotomy	Nil	1.3	6.9
9	ESWL	Nil	1.5	12.3
10	PCNL	5–17.9	4.2	30.8
11	URS	2–5.4	3.1	24.3
12	Cystolithotripsy	Nil	2.2	15.3
13	Urethrolithotripsy	Nil	0	1
14	Spontaneous passage	Nil	0	1
	Total 434	17		

ESWL extracorporeal shock-wave lithotripsy, *PCNL* percutaneous nephro-lithotomy, *URS* Ureterorenoscopy

Table 4 Complications recorded on different modalities of stone retrieval

No.	Procedure (number of complications out of the total)	Urine leak no. and %	Wound infection/UTI no. and %	Urinoma no. and %
1	Nephrectomy (0/1)	Nil	Nil	Nil
2	Nephrolithotomy (2/48)	Nil	1–2.1	1–2.1
3	Pyelonephrolithotomy (7/64)	1–1.6	6–9.4	Nil
4	Extended pyelolithotomy (2/28)	Nil	2–7.1	Nil
5	Pyelolithotomy (2/64)	1–1.6	1–1.6	Nil
6	Ureterolithotomy (1/35)	1–2.9	Nil	Nil
7	Cystolithotomy (0/5)	Nil	Nil	Nil
8	Urethrolithotomy (0/4)	Nil	Nil	Nil
9	ESWL (0/36)	Nil	Nil	Nil
10	PCNL (5/28)	3–10.7	1–3.6	1–3.6
11	URS (2/37)	Nil	2–5.4	Nil
12	Cystolithotripsy (0/12)	Nil	Nil	Nil
13	Urethrolithotripsy (0/1)	Nil	Nil	Nil
14	Spontaneous passage (0/76)	Nil	Nil	Nil
	Total (21/434)	6–1.4	13–3.0	2–0.5

ESWL extracorporeal shock-wave lithotripsy, *PCNL* percutaneous nephro-lithotomy, *URS* ureterorenoscopy

had successful PCNL, postoperative morbidity was significantly reduced in terms of the number of days of hospitalization, time taken for return to work, and absence of

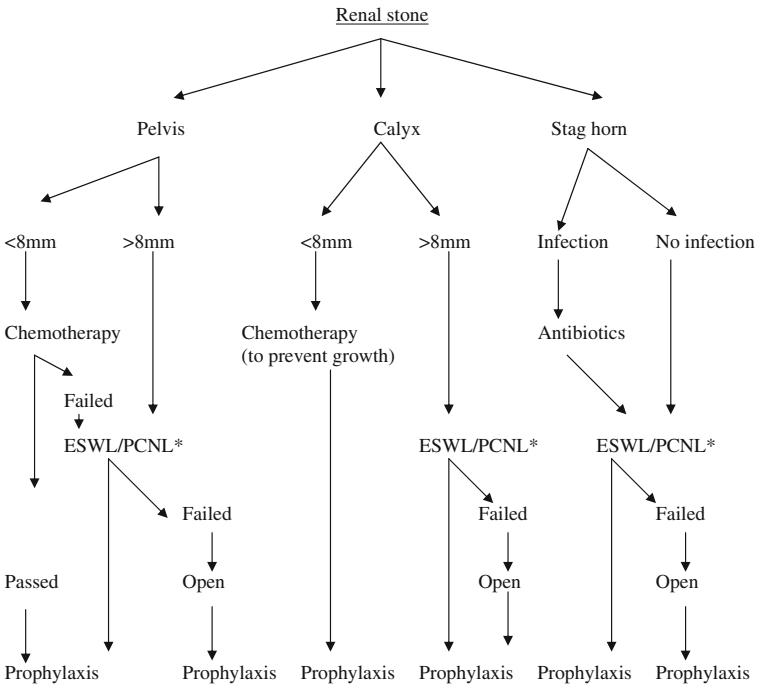
Fig. 8 Large bladder stone, ideal for open surgery

urinary leak, site infection, urinoma formation and urinary tract infection.

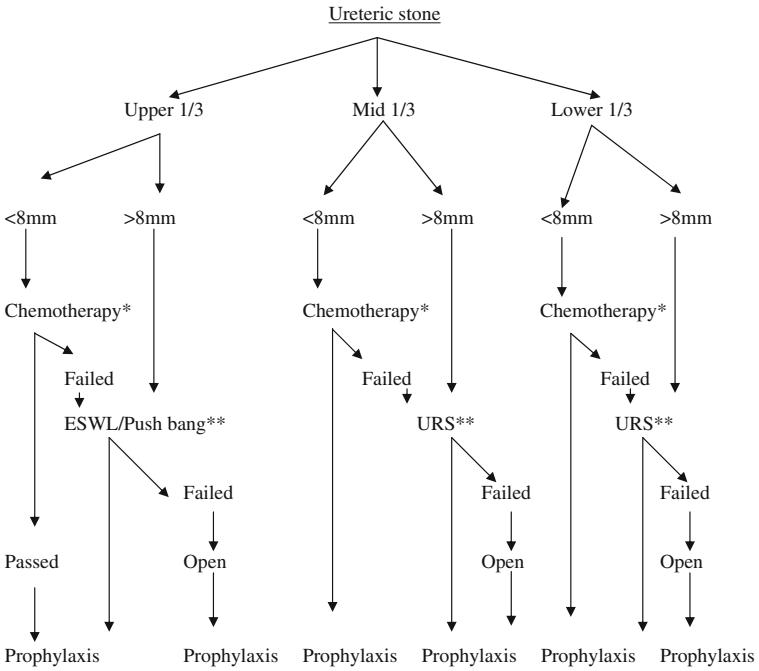
URS was performed in many patients and the stones retrieved. However, the indication for the procedure remains doubtful as the size of the stones thus retrieved was less than 6 mm in most cases. These would have passed out spontaneously or with chemotherapeutic support (Fig. 6). URS, lithotripsy and basketting resulted in the upward migration of the stones to the kidney, requiring further procedures for retrieval. Introduction of double J stents helped in relieving urinary obstruction, particularly in patients presenting with anuria, but retained stents, forgotten stents and failed stone retrieval were common following the procedure. The procedure of URS was simplified by the presence of dilated ureter in spontaneous stone passers or those with distal obstruction and proximal dilatation. Failed URS was basically noted in larger ureteric stones, particularly in the upper one-third. Figure 7 depicts the postoperative X-ray of a patient who could not get the DJ stents passed beyond the stones even after ureteroscopic attempt elsewhere. The patient was later on cleared by URS in a subsequent sitting.

The morbidity pattern of different modes of treatment was recorded under three heads, namely the complication rate, the number of hospital days and the days taken for the patients to return to work (Table 3). The complications were maximum following PCNL and least following open surgical procedures. The notable complications included urine leak, wound infection and urinoma (Table 4, Fig. 8).

It is generally reported from Western countries that ESWL, PCNL and endoscopic procedures form the mainstay in the treatment of renal stones and that open surgery is relegated to less than 1% of the total patients even with difficult renal stones [8] and in children [9]. Endoscopic techniques have superseded open surgical procedure in ureteric [10] and bladder [11] stones. Advances in stone breaking instrumentation [12–14] have improved the stone clearance rates even in large bladder stones. The Kerala



** When ever patient cannot afford costly procedure, low cost open surgery was decided.*
** ESWL selection is based on power of machines to break stones satisfactorily*
** Success rate in PCNL would be decided by operator efficiency*
** Open surgery is preferred for large brittle stones (whewellite, uric acid and cystine)*

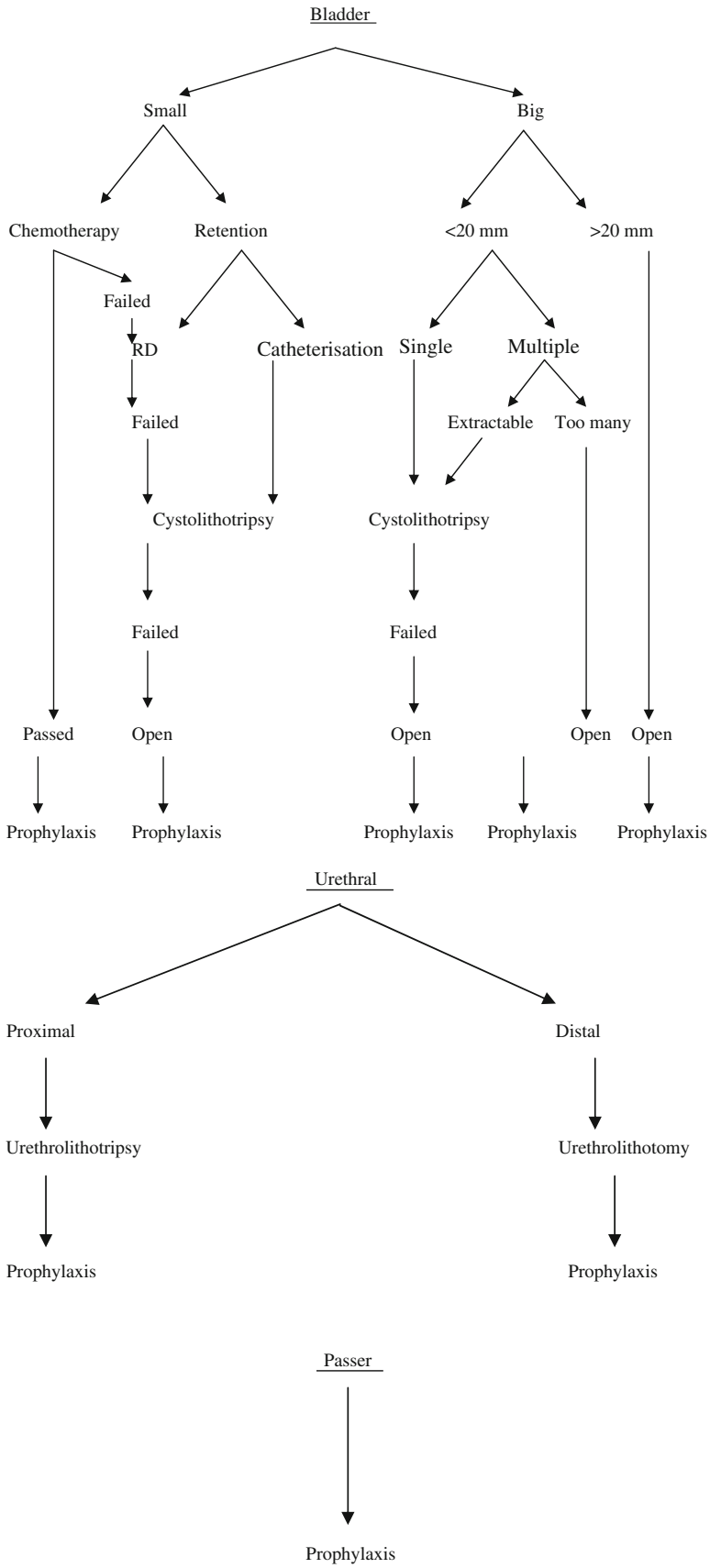


**Ureteric muscle relaxants may help passage of stones*
*** When ever patient cannot afford costly procedure, low cost open surgery is decided.*
*** Whenever there is significant progressive obstruction, retrieval should be decided early.*
*** Unbearable pain implies decision for retrieval*

Fig. 9 Flowchart for decision-making in urinary stone management

scenario in south India, however, appears different. There is still scope for open surgery in significant number of patients. The success rate of retrieval using the newer endoscopic procedures is lower compared to stone passage, probably as a result of the positive role of chemotherapy is stone patients. The mean size of stones obtained by uretero-renoscopy is less than 8 mm. It is presumed that most of these stones would have passed with appropriate

Fig. 9 continued



chemotherapy. The failure rate of ESWL and partial clearance by ESWL and PCNL provide a negative impact on going in for those modalities of treatment in the Kerala setting. This deficiency in the results of these procedures may be due to the lack of sufficient flexible instruments for lithotripsy in endoscopic procedures. Based on the knowledge gained from this study, the authors have designed a flowchart for stone retrieval for different categories of urinary stone patients (Fig. 9. This flowchart is based on the real situation existing in the working environment of the authors and may have to be modified based on local situations.

Conclusion

It is concluded from the study that open surgery still remains the sheet anchor of treatment of urinary stones in many patients in Kerala. Newer, lesser invasive procedures should be ethically selected. Decisions should be patient based taking into consideration the quality and variety of instruments, financial status of the patients, availability of infrastructure and the expertise of the surgeon.

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